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(54) Brake Booster

(57) A low-pressure casing for a brake booster for use in an automotive vehicle comprises two sheet-metal casing shells (22, 23) sealingly interconnected by a curl-up engagement (33) of their two edges. The outer bead of the piston diaphragm 7 is clamped between the two shells. The interconnection is preferably at a corner between the peripheral surface and an end wall of the casing.

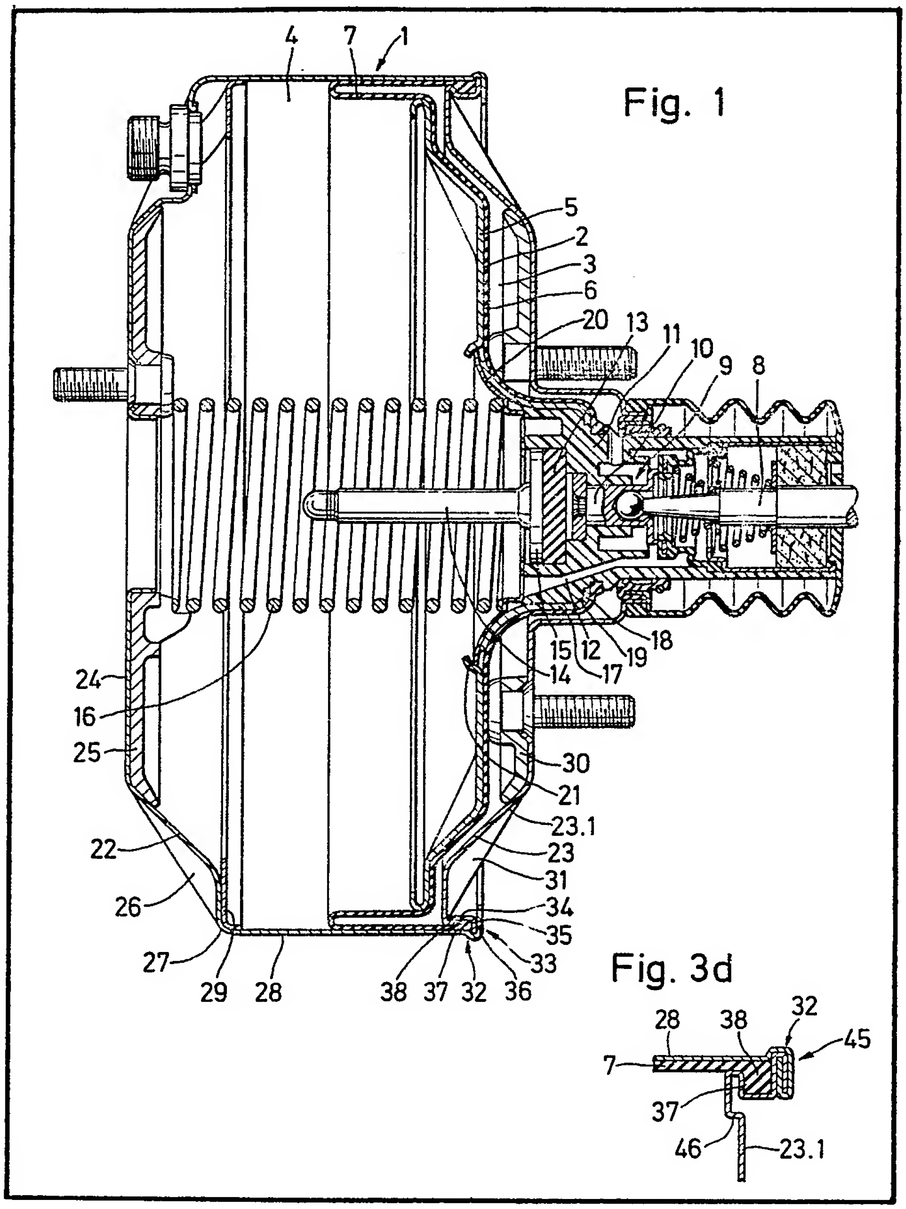

Fig. 1

Fig. 3d

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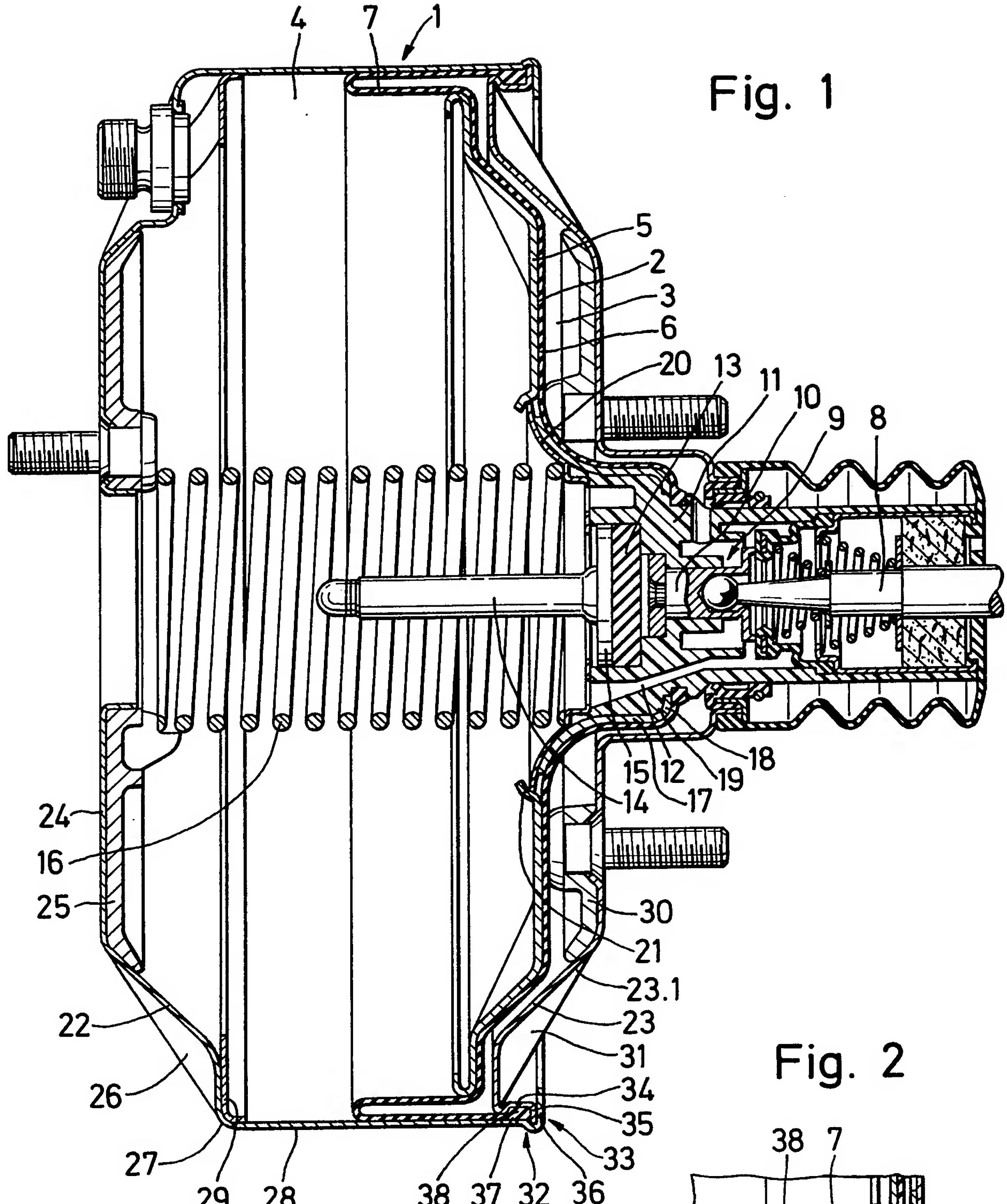
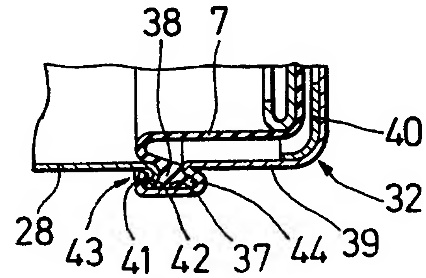


Fig. 1

Fig. 2



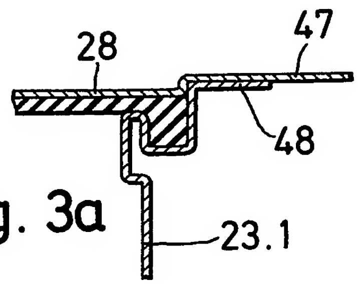


Fig. 3a

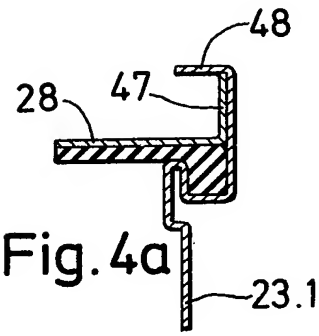


Fig. 4a

Fig. 3b

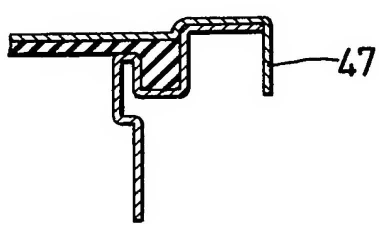


Fig. 4b

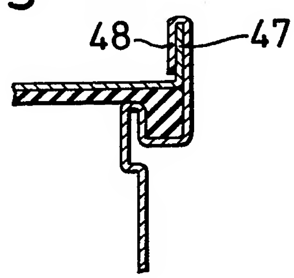


Fig. 3c

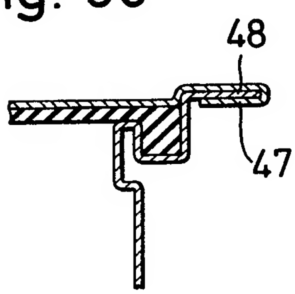


Fig. 4c

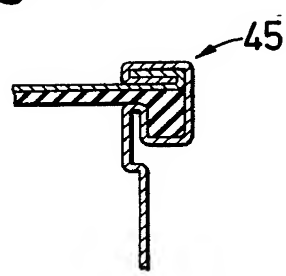


Fig. 3d

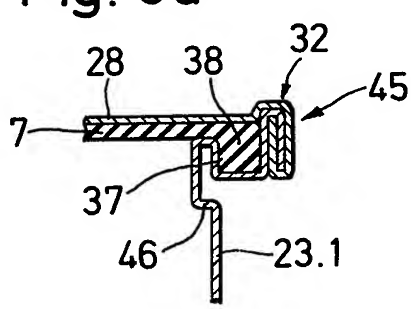


Fig. 5a

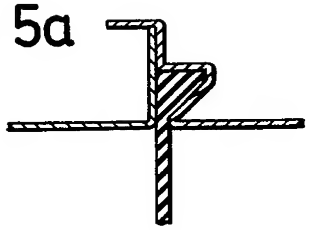


Fig. 5b

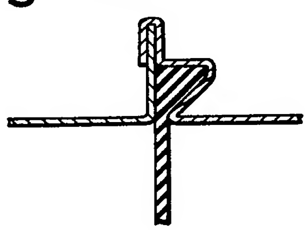


Fig. 5c

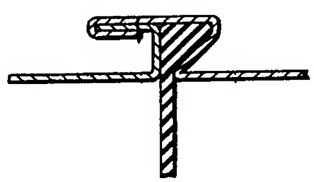


Fig. 5d

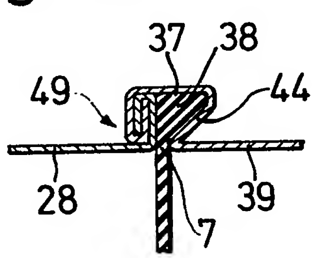


Fig. 6a

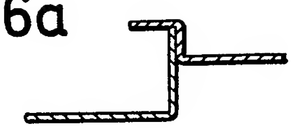


Fig. 6b

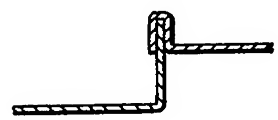


Fig. 6c

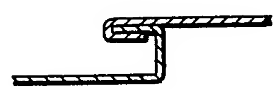
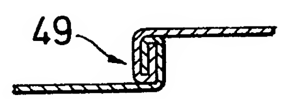


Fig. 6d



SPECIFICATION
Brake Booster

This invention relates to a low-pressure casing for a brake booster for use in an automotive vehicle, of the kind comprising two sheet metal casing shells which are sealingly interconnected at the casing periphery, with an axially movable wall which sealingly subdivides the low-pressure casing into a low-pressure chamber and a working chamber and which is composed of a rigid diaphragm plate and a flexible diaphragm, the latter forming a rolling diaphragm between the outer periphery of the diaphragm plate and the low-pressure casing, with the rolling diaphragm's outer bead being clamped at the junction of the two casing shells.

In low-pressure brake boosters for automotive vehicles, the master brake cylinder is secured to the one end wall of the lowpressure casing, while the other end wall is fastened to the automotive vehicle, preferably to the splashboard or bulkhead. The brake forces which are transmitted onto the actuating piston of the master brake cylinder when braking have to be re-transmitted as reaction forces from the master brake cylinder onto the point where the brake booster is fastened to the automotive vehicle. Taking into consideration that these comparatively large tractive forces are transmitted via the low-pressure casing, the low-pressure casing has so far been of a comparatively thick-walled design which, however, acted adversely to a generally desired reduction of the brake booster's weight.

A substantial reduction in weight by a low-pressure casing design with thin walls may be achieved if the tractive forces are transmitted via separate tie elements, for instance tie bolts (see, for example, German printed and published patent application DE-OS 28 45 794) or via a central reinforcement tube which interconnects the two end walls of the low-pressure casing (e.g. German printed and published patent application DE-OS 28 37 911). In any case, the sealing of the axially movable wall at the point where these tie rods extend through it necessitates additional structural arrangements.

It has proved that even in the event of the reaction tractive forces being transmitted via the low-pressure casing, i.e. without using separate tie elements, a very thin-walled and therefore light-weight design of the lowpressure casing is possible, if reinforcements are provided in both end walls which enable the end walls to be subjected to an increased bending strain, while the circumferential section of the low-pressure casing is substantially exposed to only such an amount of tensile strain as a thin-walled component is able to transmit sufficiently. In this respect, an inside reinforcement of the low-pressure casing in the area of the two casing edges at the transition between the end walls and the cylindrical circumferential wall has proved an important factor.

Since for reasons of manufacture and in particular for reasons of assembly the low-pressure casing is required to be made of separate components, with the two casing shells forming the low-pressure casing being required to be sealingly interconnected at the casing periphery, a suitable connecting means has to be found with respect to the above mentioned thin-walled low-pressure casing design.

It is, therefore, an object of the present invention to improve upon a low-pressure casing of the kind initially referred to in such a manner that the connection of the two casing shells provides ease of manufacture, increases the weight of the low-pressure casing only to an immaterial degree and guarantees the transmission of the high tractive forces occurring despite a small wall thickness of the low-pressure casing.

This object is achieved by the present invention in that the two casing halves are connected by a curlup engagement of their two edges. This curl-up engagement provides extreme ease of manufacture and transmits a high amount of force, with the introduction of force into the adjacent casing sections taking place without the occurrence of peaks of stress. Separate connecting elements of a concentration of material, as for example connecting flanges, are avoided which has a particularly favourable effect on the light-weight construction of the low-pressure casing.

Even if the casing is of a very thin-walled design, the curl-up engagement in accordance with the present invention does not incur any difficulties. In this case, the edges will be suitably beaded together in the curl-up engagement, i.e. they are rolled up several times.

In a particularly advantageous embodiment of the idea of the present invention, the curl-up engagement is arranged for in the area of a casing edge at the transition between an end wall of the low-pressure casing, preferably of the end wall close to the working chamber, and a cylindrical circumferential wall. A particularly thin wall thickness of the low-pressure casing may be realised by tightly fitting an inner ring in the area of the two casing edges which will absorb forces in radial and tangential directions. If the curl-up engagement is placed at such a casing edge in the manner suggested by the present invention, the curl-up engagement itself will take care of the function of the ring which may thereby be dispensed with, so producing a further reduction in weight.

Moreover, when arranging for the curl-up engagement at a casing edge, a structure, which is particularly favourable with respect to manufacturing technique may be achieved without additional expenditure of material and thus without a weight increase, in that the end wall includes at its periphery a cylindrical portion which is angled oppositely to the cylindrical circumferential wall and which passes over into an outwardly extending flange, and in that this flange is engaged from behind by an inwardly

angled curl-up flange of the cylindrical circumferential wall.

In an improvement of the idea of the present invention, the outer bead of the rolling diaphragm is clamped in a casing groove which is formed between the curl-up engagement and a circumferential fold established at the adjacent end wall or the cylindrical circumferential wall of the low-pressure casing. The casing groove required to receive sealingly the bead of the rolling diaphragm is thereby provided with very little manufacturing effort.

With the curl-up engagement being placed at the casing edge, the casing groove to receive the outer bead of the rolling diaphragm will be suitably formed between the cylindrical portion of the end wall and the cylindrical circumferential wall. In this arrangement even the separate circumferential fold for establishing the casing groove may be dispensed with.

Embodiments of the invention will now be described by way of example with reference to the accompanying drawings, in which:

Fig. 1 is a sectional view of brake booster,

Fig. 2 is a partial section at the casing periphery of a modified embodiment of the brake booster according to Fig. 1, and

Figs. 3 to 6 are varying embodiments of the curl-up engagement, shown in several stages of manufacture.

The brake booster shown in Fig. 1 includes a low-pressure casing 1 which is subdivided into a working chamber 3 and a low-pressure chamber 4 by an axially movable wall 2. The axially movable wall 2 is composed of a sheet-metal deep-drawn diaphragm plate 5 and a flexible diaphragm 6 abutting thereon and forming a rolling diaphragm 7 as a seal between the outer circumference of the diaphragm plate 5 and the low-pressure casing 1.

A control valve 9 actuatable by a piston rod 8 has a control valve piston 10 which is connected to the piston rod 8 and which performs valve openings in a control valve housing 11 in such a manner that the working chamber 3 communicates in the inactivated position shown in Fig. 1 with the low-pressure chamber 4 via air channels 12 with extend laterally in the control valve housing 11 and which have their outlet at the end face periphery of the control valve housing 11. Actuation of the control valve 9, i.e. axial displacement of the piston rod 8, will interrupt the connection between the low-pressure chamber 4 and the working chamber 3. The working chamber 3 will be connected to atmosphere so that the movable wall 2 moves towards the low-pressure chamber 4.

The braking force will be transmitted onto an actuation piston of a (non-illustrated) master cylinder of the brake unit, the latter being fastened to the end of the brake booster close to the low-pressure chamber, via a rubber-elastic disc 13, which is accommodated in an indentation on the end face of the control valve housing 11, and via a push rod 14, which incorporates a top flange 15.

A compression spring 16 which bears against one end wall 24 of the low-pressure casing 1 and against the diaphragm plate 5 maintains the movable wall 2 in the initial position shown.

The diaphragm plate 5 includes a cup-shaped hub member 17 from which a holding flange 18 extends radially inwardly and abuts at a shoulder 19 of the control valve housing 11.

A retaining plate 20 made of sheet metal is fixed at the diaphragm plate 5 by means of tongues 21 punched out of the diaphragm plate 5 (by forming indentations) and abuts at the end face of the control valve housing 11. If the brake is actuated only mechanically upon failure of the low pressure, the retaining plate 20 will transmit an axial force from the control valve housing 11 onto the diaphragm plate 5 and drive the latter. At the same time, the retaining plate 20 keeps the push rod 14 from dropping out when the master cylinder is dismounted, as the inner edge of the retaining plate 20 secures the top flange 15 of the push rod 14 in the recess of the control valve housing 11.

The low-pressure casing 1 comprising two casing shells 22, 23 made of comparatively thin sheet metal. A reinforcement plate 25 abuts at the interior of the end wall 24 of the casing shell 22 on the side close to the master cylinder. The annular portion of the end wall 24 which is disposed outside the reinforcement plate 25 is of a flat, conical design and has radial depressions 26 for reinforcement. At a casing edge 27 the end wall 24 of the casing shell 22 adjoins a cylindrical circumference wall 28. In the area of the casing edge 27, a reinforcement ring 29 is inserted inwardly which absorbs radial and tangential forces.

Similarly a reinforcement plate 30 abuts at the interior of the end wall 23.1 of the low pressure casing 1 on the side close to the working chamber. The end wall 23.1 is in the annular area outside the reinforcement plate 30 of a flat, conical design and has radial depressions 31.

At the casing edge 32 on the side close to the working chamber, the two casing shells 22, 23 are interconnected by a curl-up engagement 33. The casing shell 23 forming the end wall 23.1 has at its periphery a cylindrical portion 34 which is angled oppositely to the cylindrical circumferential wall 28 and which passes over into a narrow, outwardly extending, flange 35. The flange 35 is engaged from behind by an inwardly angled curl-up flange 36 of the cylindrical circumferential wall 28.

Formed between the cylindrical portion 34 and the circumferential wall 28 in the area of the curl-up engagement 33 is a casing groove 37 which sealingly receives an outer bead 38 of the rolling diaphragm 7.

As may be clearly seen from Fig. 1, for provision of the curl-up engagement 33 both the inside of the cylindrical portion 34 and the outside of the cylindrical circumferential wall 28 are

available to introduce the curl-up forces and are easily accessible for the curling-up tools.

Fig. 2 shows a variant of the embodiment of the curl-up engagement between the two casing shells 22 and 23. In this arrangement, the casing shell 23 is also connected to a cylindrical circumferential wall 29, with a ring 40 being likewise inserted inwardly at the casing edge 32. An inwardly extending flange 41 of the circumferential wall 39 engages behind an outwardly extending flange 42 of the circumferential wall 28 of the casing shell 22 thereby providing a curl-up engagement 43 which is suitable for the transmission of tractive forces.

In this structure, the circumferential casing groove 37 which sealingly receives the bead 38 of the rolling diaphragm 7 will be formed between the curl-up engagement 43 and a circumferential fold 44 established in the circumferential wall 39.

Fig. 3*d* shows a modified embodiment of a curl-up engagement 45 which is, similarly to Fig. 1, formed at the casing edge 32 between the end wall 23.1 and the circumferential wall 28. A double fold 46 extends from the end wall 23.1 inwardly and is angled upwardly. This produces the casing groove 37 which receives the bead 38 of the rolling diaphragm 7.

It is common to the embodiments of curl-up engagements shown in Figs. 3 to 6 that the casing parts to be connected are composed of very thin sheet metal. For this reason, the sheet metal edges are folded one around the other to establish the curl-up engagement and are afterwards beaded once more in combination. This procedure will be described by way of example in relation to Figs. 3*a* to *d*; this description will also be true for the embodiments according to Figs. 4, 5 and 6.

As is shown in Fig. 3*a*, during the assembly of the low-pressure casing, the edge 47 of the circumferential wall 28 will first be placed on an outwardly projecting flange 48 of the end wall 23.1 so that it stands out. Starting from this initial state according to Fig. 3*a*, the edge 37 will be angled downwardly in the first curl-up operation (Fig. 3*b*). In the second curl-up operation (Fig. 3*c*), the edge 47 will be wrapped completely around the flange 48. Together, these parts will then be turned over downwardly in the third curl-up operation and will take the final position shown in Fig. 3*d*.

In the embodiment according to Fig. 4, the edge 47 of the circumferential wall 28 is angled upwardly to form a radial flange. With its similarly angled flange 48, the end wall 23.1 extends beyond the edge 47 (Fig. 4*a*). Subsequently, the flange 48 will be folded over the edge 47 (Fig. 4*b*) and jointly beaded therewith (Fig. 4*c*).

Similarly to Fig. 2, Figs. 5 and 6 show the connection of two cylindrical circumferential walls 28 and 39 by a curl-up engagement 49, with the edges of the circumferential walls 28 and 39 to be connected being folded one around the other and jointly beaded as has been described with respect to Figs. 3 and 4.

The embodiment according to Fig. 5 is intended for a brake booster with one working chamber and one low-pressure chamber only. Therefore, there is provided, similarly to Fig. 2, a fold 44 spaced from the curl-up engagement 49 to form the under-cut casing groove 37 which receives the bead 38 of the rolling diaphragm 7. In contrast, there exists no such casing groove 37 in the event of the curl-up engagement 49 according to Fig. 6 which is meant for a tandem-design brake booster.

In Figs. 5 and 6, the partial figures *a, b, c, d* likewise show the successive operating stages.

Claims

1. A low-pressure casing for a brake booster for use in an automotive vehicle, of the kind comprising two sheet-metal casing shells which are sealingly interconnected at the casing periphery, with an axially movable wall which sealingly subdivides the low-pressure casing into a low-pressure chamber and a working chamber and which is composed of a rigid diaphragm plate and a flexible diaphragm, the latter forming a rolling diaphragm between the outer periphery of the diaphragm plate and the low-pressure casing, with the rolling diaphragm's outer bead being clamped at the junction of the two casing shells, characterised in that the two casing shells (22, 23) are interconnected by a curl-up engagement (33, 43, 45, 49) of their two edges.

2. A low-pressure casing as claimed in claim 1, characterised in that the edges (47, 48) are jointly beaded in the curl-up engagement (45, 49).

3. A low-pressure casing as claimed in claim 1, characterised in that the curl-up engagement (33, 45) is arranged in the area of a casing edge (32) at the transition between an end wall (23.1) of the low-pressure casing (1), preferably the end wall close to the working chamber, and a cylindrical circumferential wall (28).

4. A low-pressure casing as claimed in claim 3, characterised in that the end wall (23.1) has at its periphery a cylindrical portion (34) which is angled oppositely to the cylindrical circumferential wall (28) and which passes over into an outwardly extending flange (35) and in that the flange (35) is engaged from behind by an inwardly angled curl-up flange (36) of the cylindrical circumferential wall (28).

5. A low-pressure casing as claimed in claim 1, characterised in that the outer bead (38) of the rolling diaphragm (7) is clamped in a casing groove (37) which is formed between the curl-up engagement (33, 43, 45, 49) and a circumferential fold (44, 46) established at the adjoining end wall (23.1) or the cylindrical circumferential wall (28) of the low-pressure casing (1).

6. A low-pressure casing as claimed in claim 4 or 5, characterised in that the casing groove (37)

is formed between the cylindrial portion (34) and the cylindrical circumferential wall (28) to receive the outer bead (38) of the rolling diaphragm (7).

7. A low-pressure casing for a brake booster substantially as described with reference to the accompanying drawings.

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